SS – 321

V Semester B.Sc. Examination, Nov./Dec. 2018
(CBCS) (Fresh) (2018-19 and Onwards)
PHYSICS – Paper – V
Statistical Physics, Quantum Mechanics – I, Atmospheric Physics and Nanomaterials

Time : 3 Hours

Max. Marks : 70

Instruction : *Answer **five** questions from **each** Part.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. What is photon gas ? Derive Planck's law of blackbody radiation starting from Bose-Einstein distribution law. **(2+6)**

2. a) Write the expression for Fermi-Dirac distribution function. Explain the variation of f(E) versus E with respect to temperature.

   b) Explain the contribution of free electrons to specific heat of metals. **(5+3)**

3. a) Explain phase velocity and group velocity for a matter wave.

   b) Establish the relation between the phase and group velocity of a non relativistic free particle. **(4+4)**

4. With relevant theory, explain Davisson-Germer experiment to demonstrate de-Broglie hypothesis. **8**

5. a) Explain hydrostatic Balance.

   b) Obtain an expression for hydrostatic balance and hence an expression for the variation of pressure with height. **(2+6)**

6. Explain four distinct properties of nanomaterials. Mention any four applications of nano materials. **8**

P.T.O.

7. a) What are macro and micro states ? Define thermodynamic probability. Express Entropy in terms of thermodynamic probability.

   b) Describe how classical physics fails and quantum theory helps in explaining Compton effect. **(4+4)**

8. a) Write a note on :

   i) River bank erosion and

   ii) Cyclones.

   b) What are one and two dimensional nanosystems ? **(6+2)**

PART – B

Answer **any five** of the following questions. **Each** question carries **four** marks. **(5×4=20)**

[$h = 6.625 \times 10^{-34}$ JS, $k = 1.38 \times 10^{-23}$ J/K,

$e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg,

$m_n = 1.67 \times 10^{-27}$ kg, $m_p = 1.67 \times 10^{-27}$ kg]

9. Five Bosons are distributed in two compartments. First having 3 cells and the second 4. Find the thermodynamic probability for macro-state

   a) (5, 10)

   b) (4, 1)

10. Estimate the fraction of electrons excited above the Fermi level at room temperature for copper. Given the Fermi energy of copper is 5 eV.

11. Calculate the maximum velocity of photoelectrons, if ultraviolet radiation of 260 nm is incident on silver whose threshold wavelength is 380 nm.

12. Calculate the de-Broglie wavelength of neutron of energy 28.8 eV. Given mass of neutron is 1.67×10^{-27} kg.

13. The pressure at Station A is 1×10^5 Pa and that at Station B is 1.05×10^5 Pa. The distance between Stations A and B is 100 km. If the density of air is 1.23 kg m^{-3}, calculate the pressure gradient force per unit mass.

14. Find the Coriolis force per unit mass at a hill station at 30° N having a Zonal wind speed of 15 ms^{-1}.

15. A proton has a kinetic energy of 100 eV. Calculate the group and phase velocities. Given mass of proton is 1.67×10^{-27} kg.

16. The position uncertainty of an electron having a kinetic energy of 0.3 keV is 0.3 nm. What is the percentage uncertainty in its momentum ?

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

17. a) Can Maxwell-Boltzmann statistics be applied to electron gas ? Explain.

    b) Do particles like electron, proton and neutron obey Pauli's exclusion principle ? Explain.

    c) Even though monochromatic X-rays are used, the Compton spectrum contains more than one line. Explain.

    d) Does the concept of Bohr's orbit violate uncertainty principle ? Explain.

    e) Is water vapor a green house gas ? Explain.

    f) In which layer of the atmosphere satellites are placed and why ?

    g) Is helium a liquid even at absolute zero temperature ? Why ?

    h) Graphene is the strongest nano-material. Justify.
